REMARKS

Request for Withdrawal of Finality of Office Action

The Office Action of May 21, 2009 indicates that Applicant's arguments filed February 9, 2009 are moot in view of the **new grounds of rejection**. The Examiner indicates in paragraph 1 of the Office Action that **the art** relied upon in the new rejection **is new and distinct** from the art previously relied upon. Further, **the statutory basis** under which the art rejections were made **are now different**. The Examiner concludes with the statement "**the grounds of rejection** in the instant action **are new and distinct** from the rejection of the previous office action."

Pursuant to MPEP 706.07(a) "Final Rejection, When Proper on Second Action [R-6]" a second or any subsequent actions on the merits shall be final, except where the examiner introduces a new ground of rejection that is neither necessitated by applicant's amendment of the claims, nor based on information submitted in an information disclosure statement filed during the period set forth in 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p)."

In the Amendment filed February 9, 2009, Applicants made only one subtitle amendment to the claims – to provide a more correct translation of the original German text so that "geographic" became "earth". This amendment did not change the claims so as to necessitate new grounds of rejection, and the Examiner has not given any indication why this slight change in the claim necessitated the citation of new art and entirely new grounds of rejeetion.

Finally, it would be unfair for Applicants to have no opportunity to adapt claims and provide arguments in respond to the entirely new art and new grounds of rejection.

Accordingly, withdrawal of the finality of the Office Action of May 21, 2009 and entry and full consideration of the present Amendment is respectfully requested.

Status of Claims

Claims 1-20 are canceled. Claims 21-42 are pending in the application.

Claims 21 and 33 are amended based on paragraph [0015] of the specification as published to recite that the angle sensors are provided on the mast arms ***away from the articulation*** axes. Thus, the claims do not read on angle sensors mounted at the articulation linkages.

Response to Arguments:

The Examiner indicates that Applicant's arguments are moot in view of the new ground(s) of rejection and new the statutory basis under which the art rejections were made.

Claim Rejections - 35 USC § 112

Claims 29-32 and 39-42 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claims 29 and 39, according to the Examiner lines 1-3 recite "wherein a software routine (78) responsive to dynamic angle measurement values (α_{iv}) for the dividing thereof into low frequency and high frequency angle measurement value components". The terms "dynamic" and "frequency" modify the terms "angle measurement". Various interpretations of the claim are possible.

In response, Applicants first refer the Examiner to the background section of the newly cited Rau patent US 6,883,532, teaching at col. 1, lines 25 on, that ***mechanical oscillations*** occur in bendable booms. The bendable boom of a large-scale manipulator of this type is, due to its construction, a system capable of ***elastic oscillation***, which can be excited to internal oscillations. A resonance excitation to such oscillations can lead thereto, that the boom tip oscillates with amplitudes of one meter or more. An excitation to oscillation could be for example the pulsing operation of a concrete pump and the therefrom resulting periodic acceleration and retardation of the column of concrete forced through the conveyance line. This can lead to loss of precise

control of the boom tip, and can endanger workers.

As taught in the first full paragraph in col. 2 of Rau '532, the internal oscillations may be dampened using a dynamic damping signal. However, to know which boom movements are to be dampened, it is first necessary to be able to distinguish between boom oscillations and boom movement due to position control. For this, a ***cutoff frequency*** is set depending upon the mechanical internal harmonic frequency of the concerned boom arm (which may be from ***0.2 to 10 Hz*** – col. 2, lines 15 and 53). If an oscillation exceeds the predetermined cutoff frequency, the frequency is filtered out and phase delayed or amplified for formation of a damping signal (col. 2, lines 9-12). If an angle change is below the frequency, it is judged to be a control movement and is not dampened. As indicated at col. 3, line 5 on "Thereby the bendable boom can be *controlled* by the pump operator on the basis of movement data input into the remote control device, while the boom *dampening* occurs automatically during the movement process and while the bendable boom is in the work position."

While the main feature of the present invention is the use of separate earth-referenced angle sensors (i.e., gravity based or GPS based) for separate sensing of individual boom arms, in a preferred embodiment of the present invention, as claimed in claims 29 and 39, the boom is provided with oscillation damping. For this, it is necessary to know the oscillation frequencies of the individual boom arms. The coordinate transformer includes a software routine for translating geographically referenced mast arm base angle values into chassis referenced cylinder coordinates (r, h) for the mast tip or the end hose (claims 27, 37). A software routine (78) responsive to the dynamic position measurement values is provided for their distribution or subdivision into low frequency and high frequency position measurement components, wherein the low frequency or stationary movements are considered control movements, and wherein the high frequency position measurement components are considered oscillations to be damped. The separation is performed with a low pass filter, which is represented by the filter routine (78) in the embodiment of Fig.4.

As explained in paragraph [0025], the deconstruction of the dynamic angle measurement values leads thereto, that various control signals are assigned to different categories, and are evaluated in different control circuits:

- a ***guide value controller***, which influences the guide relationship or behavior input by the ***operator*** and
- an ***error value controller***, which influences the ***oscillation*** behavior.

The two control groups are acted upon with the instantaneous value components from this disassembly. The set or desired values of the ***guidance value controller*** are produced from the incoming data, for example, of a ***joy stick***, thus from the input of the operator, with supplemental taking into consideration a preset path/slew characteristic, while the sub-divided out ***error or interference values*** are controlled via the error or interference value controller for the purpose of controlling the ***oscillation dampening*** to zero. The low-frequency component is used via the command-variable controller 84 to control me movement of the mast arms. The higher frequency component is used as a disturbance feedforward control via the disturbance-controller 88 for damping the mast arms.

The specific frequency limit is not a specific fixed value. In the case of mast arms, the limit frequency is lower than the resonance frequency of the distributing boom, i.e. lower than approximately 1 Hz. The reaction time of the command-variable controller (84) is therefore lower than the limit frequency. It is understood that the low-frequency component also comprises the stationary component. All oscillations higher than the limit frequency are unified (summed) as a disturbance and fed forward to the disturbance controller for the purpose of damping oscillations.

Accordingly, withdrawal of the rejection of claims 29 and 39 is respectfully requested.

Regarding claims 30 and 40, line 2 recites "***the*** stationary or low frequency component". Despite the antecedent basis indicating otherwise, this term is not previously introduced earlier in the claim or in claim 28, upon which claim 30 depends.

Applicants appreciate the suggestion that claims 29 and 39 should perhaps depend from claims 28 and 38, respectively.

In response, Applicants believe deletion of the term "the" from claims 29 and 39 removes the antecedent basis issue without possible conflict with language in the immediately preceding claim language.

Accordingly, withdrawal of the rejection is respectfully requested.

<u>Claim Rejections - 35 USC § 103</u>

Claims 21-22 and 25-27 are rejected under 35 U.S.C. §103(a) as being obvious over Rau (6,883,532).

Regarding claim 21, according to the Examiner Rau discloses a large manipulator of the type presently claimed, including a control unit for actuating the drive units for mast movement, the control unit including a coordinate transformer that responds to guiding parameters for the mast tip or for an end hose located thereon, and ***to measured angular values*** that are determined by means of ***angle sensors*** on the mast arm for translation into articulation axis referenced movement signals for the drive units in accordance with predefined path/slew characteristics (Col. 4, lines 28-55). In general the boom tip position is calculated based on the bend angles of the linkage axis 28 to 32. However, as disclosed in Col. 5, lines 27-45, "on the last boom arm 27 a space angle sensor 94 in the form of for example an inclination sensor or distance sensor as well as an intended value storage 96 is provided." As a boom is moved into place on a job, the distance above ground or the inclination are sensed and stored. As the boom is repositioned, the angle of inclination or the distance above ground can be sensed again and the value compared with the stored value. If the instantaneous value does not agree with the stored value, drift has occurred, and the position of the boom tip is corrected:

> "Therewith in each work position, that is, at the conclusion of each repositioning process, the instantaneous angular position or the distance of the boom tip 33 from the ground can be stored in the intended value storage 96. By comparison of

> the instantaneous value with the stored intended value then, over the course of time a drift can recognized and compensated by control of at least one of the actuating elements 68 through 76 or as the case may be via the coordinate provider 64." (col. 5, lines 37 on).

The Examiner acknowledges that Rau fails to disclose more than one earth referenced sensor.

In response, Applicants point out that the Rau uses angle sensors at the articulation axis for measurement of boom angles relative to each other and for controlling boom movement, and teaches only ***one additional sensor***, which may or may not be earth referenced (e.g., may be optic or acoustic distance sensor), to compare at each new job position the inclination angle of the last boom or height of the boom tip above ground, simply for ***evaluation of drift***.

The typical device as used in Rau, in which the mast arm angle is measured in an articulation axis referenced chassis-based coordinate system, has the following disadvantages:

a) The assembly of the angle sensors in the area of the articulation axes is laborious, since the design provides for many components to already be located in the area of the axis, which interfere with the attachment of the angle sensor.

b) The weight of the axis-associated angle sensor inclusive of cabling is approximately 50 Kg per axis, which is relatively high.

c) With the articulation axis associated angle sensors only the articulation axes are measured, and this without taking into consideration the bending of the individual mast arms. For the bending due to the torsional moments, with and without filling of the distribution pipes with concrete, a supplemental mathematical model is necessary, which can introduce errors.

The present invention uses a fundamentally new strategy for controlling boom arms.

In the present invention, the heavy articulation axis angle sensors are replaced by light weight, ***earth referenced angle sensors*** (tilt sensors, inclination sensors, GPS based sensors) which are not provided for direct sensing of articulation angles between two booms, thus are inelastically provided on the mast arms ***away from the articulation axes*** (claims 21 and 33, as

amended) for determination of the individual mast arm associated earth referenced angular measurement values. The chassis is preferably also provided with at least one earth referenced angle sensor on the mast base and/or on the chassis for measuring an earth referenced or fixed angular measurement value associated with the mast base and/or the chassis.

In contrast to the articulation angle sensors of Rau, in the present invention the individual articulation angles can be calculated or worked out from the sensed earth-referenced angles. Having the articulation angles, then the relationship to the chassis fixed cylinder coordinates can be produced. The conventional coordinate transformation determines, from the articulation angles, the orientation of the individual mast arms in space, and from this, the instantaneous position of the end hose in the radial direction and the height above the substrate. Alternatively, the inventive geodetic angle measurement values of the mast arms can also be converted directly, without the detour over the articulation angles, into the cylinder coordinates of the end hose. In either case, the static deformation effects due to the load or torsional moments are already contained in the measurement values. Even a setup tilt attributable to a deformation in the substrate or undercarriage is already taken into consideration. Thus, mathematical calculation of the bend angles due to heavy loads acting on the arms, and the elasticity of the long arms, can be dispensed with.

Turning back to the teachings of Rau, it is clear that the single additional sensor provided on the last boom – not for controlling boom movement, but for sensing the inclination angle of the last boom or height of the boom tip above ground, so that this stored value can be compare to a value sensed at the next job position, simply for ***evaluation of drift***, has no relation to the present invention.

Accordingly, withdrawal of the rejection is respectfully requested.

Regarding claims 22 (chassis referenced coordinate system), this claim is allowable by virtue of it's dependency from allowable claim 21.

Regarding claim 25 (tilt angle sensors) according to the Examiner Rau further discloses

the system above, wherein the geodetic angle sensors are tilt angle sensors responsive to the gravity of the earth (Col. 5, lines 28-45).

In response, Applicants point out that Rau merely uses one tilt sensor to compare job-to-job inclination angles, with deviations between jobs indicating drift of the control system.

The teaching of Rau has nothing to do with the present invention which uses one earth referenced sensor on each arm, and uses these sensors in coordination with each other for guidance of the arms for both movement in response to command and for damping of oscillation. There is no way to get from the multiple heavy prior art articulation axis sensors of Rau, plus one additional sensor for sensing height over ground or inclination angle, to the present invention.

Regarding claim 26, according to the Examiner Rau further discloses wherein the coordinate transformer includes a software routine for conversion of earth referenced mast arm base angle values into articulation angles (Col. 4, lines 28-55 and Col. 5, lines 28-45).

In response, Applicants point out that Rau uses at most only ***one*** single earth referenced sensor, which is not even optimal sensor for the disclosed purpose (a sound or light based distance measurement would be more direct and accurate measurement of height above job for computing drift. Inclination is indirect and may not correctly indicate tip position). Use of one earth referenced sensor for sensing height above job for comparison with subsequent jobs is far from the present invention of using multiple earth referenced sensors measuring arm positions. Further, the advantages of the present invention – accurate measurement of bend of each arm, light weight, freedom from connection to articulation axis, and most importantly ability to coordinate multiple earth referenced sensors for control of boom arms – is not taught in Rau.

Regarding claim 27, (software routine for translating earth referenced mast arm base angle values into chassis referenced cylinder coordinates for the mast tip or the end) Rau teaches three articulation axis angle sensors and only one earth referenced sensor thus can not provide suggestion for the present system wherein only earth referenced sensors are used.

Claims 23-24 are rejected under 35 U.S.C. §103(a) as being unpatentable over Rau

(6,883,532) in view of Zhou et al. (6,341,665 B1).

Regarding claims 23 and 24, (earth reference angle sensor on mast base or chassis), since Rau fails to teach the main feature of the present invention – an earth referenced angle sensor on each boom arm as a replacement for the prior art articulation angle sensor – the secondary reference does not remedy the defects in the primary reference, thus these claims remain patentable over the combination of art.

Claim 28 is rejected under 35 U.S.C. 103(a) as being obvoius over Rau (6,883,532) in view of Katsusuke (5,363,304).

Regarding claim 28, Rau fails to disclose, but Katsusuke discloses wherein the coordinate transformer includes a software routine (Fig. 1) for conversion of the guide or command value into guide articulation angles in accordance with a predetermined path/slew characteristic of the articulated mast (Col. 3, lines 5-60) in order to provide an efficient and non-cumbersome way of controlling a mast with multiple degrees of freedom (Col. 1, lines 55-60).

In response, Applicants point out that Rau fails to teach the main feature of the present invention – an earth referenced angle sensor on each boom arm as a replacement for the prior art articulation angle sensor. The the secondary reference does not remedy the defects in the primary reference, thus these claims remain patentable over the combination of art.

Claims 33, 34 and 37 are rejected under 35 U.S.C. §103(a) as being obvious over Rau (6,883,532) in view of Kleffner (2001/0045032).

Regarding independent claim 33, (similar to claim 21 but specifying GPS module on each mast arm) Rau is cited for disclosing a large manipulator of the presently claimed type, wherein ***on***e earth referenced angle sensor, which determine earth referenced angular values of the ***last*** mast arms is disposed in a rigid manner on ***the last*** mast arm (Col. 5, lines 27-45) and wherein the coordinate transformer is fed with the measured angular values of the geodetic angle sensors (Col. 5, lines 27-45).

Rau fails to disclose more than one sensor, or that the sensor is a GPS module.

As discussed above, the present invention is based on the novel replacement of all prior art articulation angle sensors with earth referenced sensors. The replacement is not obvious because a different control strategy had to be devised to allow control of the mast arms based on individual earth referenced angle sensors. Further, the advantages – light weight, ability to mount at free space rather than at the cluttered articulation axis, and accurate measurement of bend rather than relying on mathematical model, are not apparent in advance. Thus, there is no guidance to the present system.

The Examiner acknowledges that Rau also fails to disclose, but Kleffner does disclose wherein one GPS-module is rigidly provided ***on each mast arm*** for determining the geographically referenced position measurement value of the individual mast arms.

In response, Applicants point out that Kleffner does not provide a GPS module on each mast arm of a multiple mast arm. Kleffner merely teaches that one laser receiver 30 could be provided as any ***remote position indicating apparatus***, and can be combined with other devices such as GPS. This has nothing to do with control of multiple arm distribution mast.

Regarding claim 34, see claim 22 above.

Regarding claim 37, see claim 26 above.

Claims 35 and 36 are rejected under 35 U.S.C. §103(a) as being obvious over Rau (6,883,532) in view of Kleffner (2001/0045032), and further in view of Zhou et al. (6,341,665 B1).

Regarding claim 35 and 36, Rau and Kleffner fail to disclose, but Zhou et al. discloses wherein in addition a geodetic angle sensor is provided on the mast base for measurement of an earth referenced angle value associated with the mast base and chassis respectively (Col. 6, lines 29-41) in order to stabilize the position of the boom tip (Col. 1, lines 25-52).

In response, Applicant points out that the combination of Rau and Kleffner does not reach the presently claimed basic invention, and the addition of Zhou does not remedy the deficiencies in the teachings of Rau and Kleffner.

Claim 38 is rejected under 35 U.S.C. §103(a) as being obvous over Rau (6,883,532) in view of Kleffner (2001/0045032), and further in view of Katsusuke (5,363,304).

Regarding claim 38, Neither Rau nor Kleffner disclose, but Katsusuke discloses wherein the coordinate transformer includes a software routine (Fig. 1) for conversion of the guide or command value into guide articulation angles in accordance with a predetermined path/slew characteristic of the articulated mast (Col. 3, lines 5-60) in order to provide an efficient and non-cumbersome way of controlling a mast with multiple degrees of freedom (Col. 1, lines 55-60).

In response, Applicant points out that the combination of Rau and Kleffner does not reach the presently claimed basic invention, and the addition of Katsusuke does not remedy the deficiencies in the teachings of Rau and Kleffner.

Withdrawal of the rejections is respectfully requested.

Information Disclosure Statement

Applicant filed today an IDS bringing to the attention of the Examiner a Japanese reference JP-A-2001-159518 cited in a corresponding Japanese patent application. However, the present invention is characterized by earth referenced angle sensors (44 to 48) disposed in a rigid manner on the mast arms (23 to 27) wherein the earth refereced angle sensors determine earth referenced angular values (e,,) of the individual mast arms (23 to 27).

In the JP reference El (see Fig. 4 and [00331) the angle values q1, q2 and q3 which are measured with the boom angle sensor 26, the arm angle sensor 27 and the bucket angle sensor 26 are machine referenced and not earth referenced angular values. In addition the sensors 26, 27 and 28 are mounted between the link members of the rotating shaft. They measure the geometric angle between the link members. They are no geodetic angle sensors in the sense of the invention.

It is correct that according to paragraph [0079] in the JP reference the angle sensors 26, 27 and 28 may be replaced by earth referenced (gravity) sensors in order to determine the

articulation angles. But it is stated: "In this case, the angle between the links can be gotten from the difference of the sensor signals on the tilt angle of the front and rear links."

From this it follows that the gravity sensors are disposed in the immediate vicinity of the articulation axes.

In contrast to this the angle sensors of the present invention are disposed on the mast arms 28 to 32 ***away from the articulation axes*** (claims 21 and 33, as amended). ***Only for this reason do the angle measurements contain additional information concerning the deflection or buckling of the mast system and the dynamic oscillation state.*** Further, the measured values contain information regarding a possible ***tilting and deformation of the chassis***, which may be determined by way of an additional measuring point 49 at the mast block or on the chassis.

Accordingly, it is believed that the present claims as amended are novel and unobvious over JP reference.

The Commissioner is hereby authorized to charge any fees which may be required at any time during the prosecution of this application without specific authorization, or credit any overpayment, to Deposit Account Number 16-0877.

Should further issues remain prior to allowance, the Examiner is respectfully requested to contact the undersigned at the indicated telephone number.

Respectfully submitted,

Stephan A. Pendorf
Registration No. 32,665

Patent Central LLC
1401 Hollywood Blvd.
Hollywood, FL 33020-5237
(954) 922-7315

Date: **October 21, 2009**